# ELECTROMYOGRAPHIC ASSESSMENT OF PULLOVER EXERCISE VARIATIONS AND JAVELIN THROW ON NINE UPPER-BODY MUSCLES

**Jad Adrian Washif*[1,3], Kim Hébert-Losier[2,4], and Christopher Martyn Beaven[3,4]**

[1]High Performance Centre, Institut Sukan Negara, Malaysia
[2]Biomechanics Centre, Institut Sukan Negara, Malaysia
[3]Strength and Conditioning Centre, Institut Sukan Negara, Malaysia
[4]Health, Sport and Human Performance, University of Waikato, New Zealand
*E-mail: jad_adrianwashif@yahoo.com

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## INTRODUCTION

Exercise choice is one important variable for attaining athletic training aims. Pullover exercises are integrated into resistance training programs of javelin throwers to develop event-specific strength. We examined the electromyography (EMG) signals during four pullover exercise variations: conventional (CONV), straight-arm (STR), bent-arm (BENT), and conventional on unstable surface (UNS); and javelin throwing (JAVT) using an 800 g standard implement.

## METHODS

Surface EMG of five national male javelin throwers were recorded from nine muscles on the throwing-arm side: upper trapezius; anterior, middle, and posterior deltoid; triceps brachii; clavicular and sternal portions of pectoralis major; latissimus dorsi, and rectus abdominus. In a randomised fashion, all throwers performed six repetitions of each pullover variation using a free-weight curl-barbell against an external load at 85% of 1-repetition maximum, while EMG signals were recorded during both the concentric and eccentric phases of the movement and subsequently normalized to a maximal voluntary contraction (MVC). The throwers then performed three maximal javelin throws and the one with the greatest throwing velocity was used for analysis.

## RESULTS

Generally, BENT elicited the highest peak activity of all muscles (22-89% MVC), except for the rectus abdominus which was highest during UNS (106%). In contrast, CONV tended to produce the lowest peak muscle activation (12-77%), except for the pectoral and middle deltoid muscles. It was noteworthy that despite being the same exercise, performance on the unstable surface elicited higher peak muscle activity than CONV, except from the pectoralis muscles. Peak muscle activation in JAVT ranged from 29 (posterior deltoid) to 124% (latissimus dorsi), with the relatively high peaks in the deltoids and latissimus dorsi not being matched during the pull-over exercises.

## DISCUSSION

It has been noted that pullover exercise emphasize chest muscle activation, i.e. pectoralis major (Marchetti & Uchida, 2011). Here, the level of activation depended on pullover variation, and BENT elicited the highest overall peak muscle activity. Strength and conditioning specialists should be aware of the impact of different pullover variations on muscle activation levels, and note that additional exercises to target the musculature of the shoulder and upper back should be incorporated in the training of javelin throwers.

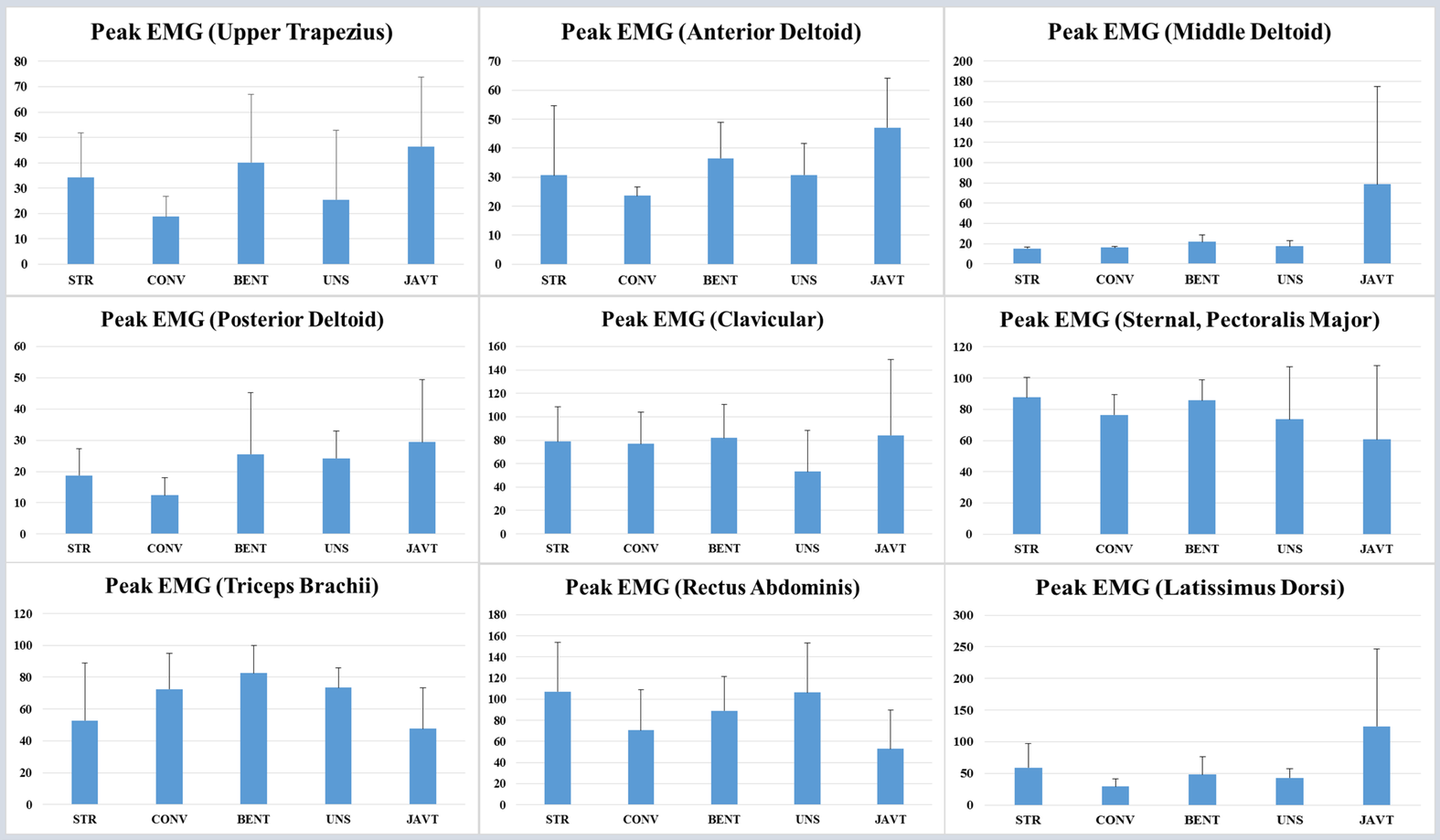


**Figure 1** Peak normalized EMG values during pullover variations and javelin throwing

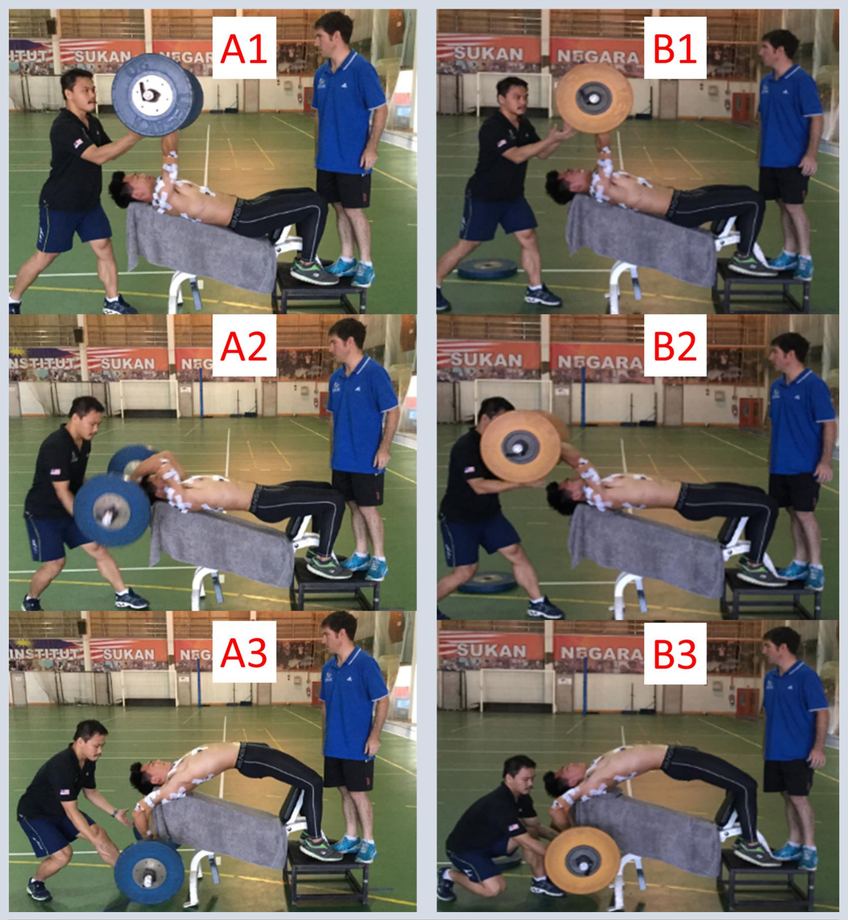


**Figure 2 A:** sequence of bent arm pullover, **B:** sequence of straight arm pullover.

## REFERENCE

Marchetti & Uchida. Effects of the pullover exercise on the pectoralis major and latissimus dorsi muscles as evaluated by EMG. *J Appl Biomech* 2011:27,380-384.

## ACKNOWLEDGMENTS

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